Forest Pest Management Report

3420
R4-93-01
January 1992

Intermountain Region, State and Private Forestry

A BIOLOGICAL EVALUATION OF SPRUCE BEETLE ACTIVITY IN THE NEFFS MANAGEMENT AREA - FISHLAKE NATIONAL FOREST, LOA RD
1992

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ABSTRACT

In 1992, increasing spruce beetle activity within and adjacent to the Neffs Management Area on the Fishlake National Forest, Loa Ranger District resulted in the need to assess current levels of beetle activity. In 1989, aerial surveys detected a small spruce beetle population in the Neffs Management Area, however populations faded until 1992 when spruce beetle activity was again observed.

Ground survey data indicate that spruce mortality has increased by 8 percent since 1991 as a result of the spruce beetle infestation. The area is considered high hazard, which means the stand is at a vegetative stage that is capable of sustaining spurce beetle populations at epidemic levels.

The results of this survey indicate that an increase in spruce mortality is likely in 1993 due to emerging populations of adult beetles from 1991 infested
trees and the high hazard conditions of suitable host type.

INTRODUCTION

Spruce beetle, *Dendroctonus rufipennis* (Kirby), is a serious pest of Englemann spruce, *Picea englemannii* (Parry) throughout it's range. Recent spruce beetle activity was aerially mapped on the Fishlake National Forest, Loa Ranger District (RD) in 1989. Beetle populations were not aerially detected in 1990 and the area was not flown in 1991. Aerial surveys conducted in 1992 detected an increase in spruce beetle populations (Figure 1).

Loa RD staff requested a biological evaluation of the Neffs Management Area to document the intensity and location of current and previous spruce beetle activity and how beetle populations will effect residual spruce. In late August and early September 1992, Forest Pest Management staff conducted a ground evaluation of the Neffs Management Area. The area of concern is located in portions of Sections 9, 10, 15 and 16, T.26S., R.3E., Salt Lake Base & Meridian, Sevier County, Utah (Figure 2). It is approximately 8 miles east of Fremont, Utah and 1 mile west of Elkhorn guard station. The area surveyed encompasses approximately 140 acres of mixed Englemann spruce, subalpine fir and aspen.

The spruce beetle, *Dendroctonus rufipennis* (Kirby), kills mature Engelmann spruce in the spruce-fir, *Picea engelmannii* (Parry) and *Abies lasiocarpa* (Hooker) Nutt., type in the Central Rockies (Schmide & Frye, 1977). Since the late 1800's, populations of this bark beetle have periodically reached outbreak proportions and killed thousands of spruce. The known outbreaks have originated from stand disturbances such as windthrow, road building or residual debris from cutting operations which create a habitat extremely conducive to brood development (Wygant and Lejeune, 1967).

The spruce beetle generally has a 2-year life cycle (Furniss and Carolin, 1977). In the 2-year cycle, which is most commonly found in our area, the adults attack weakened or windthrown trees in late spring to early summer. The eggs hatch and larvae develop throughout the summer. The larval stage predominates over the winter, although some eggs and parent adults are also present. In the 2-year cycle, larvae pupate approximately one year following adult attack. During winter of the 2-year cycle, callow adults overwinter in their pupal sites or in the base of the infested tree. Sexually mature adults emerge the following spring attacking live trees.

Outbreaks are difficult to detect because trees do not fade until the second year following attack. In mid-late summer of the second year, the needles turn a pale green before falling off the tree. Pitch tubes are not always present on attacked trees; as a result, first-year attacks are sometimes only detected by the presence of brown boring dust around the base of the tree or in bark crevices. The evidence of woodpecker activity, particularly during the winter months when pieces of bark litter the snow, is also an indication of spruce beetle activity.

During endemic years, the spruce beetle primarily attacks windthrown or weakened trees and stumps. Outbreaks are often caused by beetle populations building up in windthrown trees or logging debris, and spreading to standing trees. Although this insect will attack trees as small as 6-8 inches in diameter, it prefers larger trees in the 16 inch and above diameter classes.

This report documents the results of our biological evaluation designed to estimate current beetle activity, previous activity, species composition, stand density and susceptibility to beetle attack.

METHODS

A systematic survey of the Neffs Management Area was designed to ensure thorough coverage of the area. The survey was conducted to determine the number and location of infested trees, and the residual structure of the green stand.

Information on the number of currently infested and uninfested spruce trees by 1-inch diameter breast height (dbh) classes was gathered from a variable plot cruise. The data on currently infested trees will indicate the average dbh and number of trees killed within the survey area. All tree species 5-inches in dbh or greater within the sampling area were tallied. The green stand information was used to compute a hazard rating for the residual stand.

Along the survey lines, 3-person crews collected data in 49 variable radius plots using a 10 basal area factor (BAF) prism at 5 chain intervals (1 chain = 66 feet). Six survey lines were used, spaced 5 chains apart. Distance between plots and survey lines varied due to terrain (Figure 2). The following information was gathered at each variable radius plot:

Tree Species
Diameter at Breast Height
Tree Condition
Spruce - Green/Uninfested, Infested Current (1992), Previous Infested (1991), Older Infested (1990 and earlier) and Unknown Mortality
Other Species - Live or Dead
Stand Density / Basal Area

The data was entered and run through INDIDS (Insect Disease Damage Survey) to obtain stand averages as related to insect damage.

RESULTS

Three tree species were tallied in our survey, Englemann spruce, subalpine fir, and aspen. The live species component within the Neffs Management Area consists of 85 percent Englemann spruce, 7 percent subalpine fir, and 8 percent aspen. Live Englemann spruce, subalpine fir, and aspen average 13.8, 11.8, and 12.4 inches dbh (Table 1).

Neffs Management Area averaged 319 trees per acre before the current outbreak (Tabel 1). Green trees (live) averaged 293 trees per acre (TPA) in our survey, which represents an 8 percent reduction in TPA (Table 2). Englemann spruce averaged 242 TPA, subalpine fir 34 TPA and aspen 43 TPA (Table 1).

Spruce beetle mortality was separated into the following three categories; current-1992 attacks, previous-1991 attacks and older-1990 and earlier attacks. Spruce mortality averaged 26 TPA last year. As a result of previous and current spruce beetle mortality, basal area has declined by 15 percent. Spruce beetle mortality for the Neffs Management Area by damage category is displayed below:

Damage Category	Mean TPA	Mean DBH
Current -	26 TPA	10.3 dbh
Previous -	3 TPA	11.4 dbh
Older -	6 TPA	15.5 dbh

Englemann spruce diameters were averaged using two methods; 1) all trees 5 inches dbh or greater and 2) all trees 10 inches dbh or greater (Table 1 & 2). The 10 inches dbh and greater average was one of the parameters used to develop a stand risk rating for spruce beetle (Figure 3). Spruce beetle Hazard was determined using Schmid and Frye (1976) stand hazard rating for spruce beetle described in the Appendix.

DISCUSSION

The information gathered in the Neffs Management Area summarizes current spruce beetle activity and associated stand hazard. Since 1990, spruce beetle populations have started to expand in the Neffs Management Area.

Based on the data collected for this evaluation, much of the area surveyed is at moderate to high spruce beetle hazard. Spruce beetle is a major mortality factor in unmanaged mature stands of Englemann spruce. They have periodically depleted the dominant and codominant trees, and changed species composition where subalpine fir is a stand component.

The stand hazard rating table for spruce beetle (Appendix) was used to document current hazard within the Neffs Management Area. The physiographic location used for developing the risk map was spruce on sites with a site index of 80 to 120. Based on physiographic location, average diameter of live spruce above 10 inches dbh, basal area and proportion of spruce in the canopy an overall high hazard condition exists in residual stands. Because the insect is already present, the likelihood that many of the spruce with diameters greater than 16 inches dbh will be attacked has increased significantly.

Only four stand characteristics are used to determine hazard, however a number of other factors may also be evaluated. In stands not currently infested by spruce beetle, the forest manager may consider windthrow potential, diameter growth rates, presence of other insect/disease organisms, etc., which should be considered to decide whether the stand should be given a higher or lower rating. It is in this area where good experience and professional judgement are most beneficial.

Based on this survey and the aerial sketch map surveys conducted annually, spruce beetle populations will continue to increase. Spruce trees attacked in 1991 will have emerging adults in the spring of 1993. Because the number of attacked trees in 1991 has increased, adult flight in 1993 should be significantly more than the 1992 flight. Comparing the various damage categories representing different years of spruce beetle attack, it's obvious spruce beetle in the Neffs Management Area has a 2 year life cycle. Due to the number of currently (1992) infested trees, significant numbers of mature adult beetles will emerge in 1994.

MANAGEMENT ALTERNATIVES

1. *No Action.* This alternative would allow the infestation to continue and accept the losses in spruce until the infestation collapses naturally. Estimates of stand losses can be approximated through population surveys. Fire hazard will increase and visual quality will decrease as a result of the no action alternative. Within the Neffs Management Area, many of the larger diameter (> 16" dbh) spruce could be lost, with most of the surviving spruce in smaller diameter classes. Mortality of the residual spruce component could exceed 40-50 percent in the Neffs Management Area.

2. *Direct Suppression.* This would involve individual tree treatment. This could include; removal of infested trees, treating infested trees with a chemical insecticide, or felling and burning infested trees. Individual tree treatment is often expensive and effective only in small infestations. Chemically treated trees could be salvaged at a later date.

3. *Salvage Logging.* Both currently infested and dead trees would be removed. This alternative would utilize the dead material and assist in suppressing localized populations of the insect. In large infestations, suppressing insect populations using this alternative is not practical. This alternative would not significantly change stand conditions that influence stand susceptibility to spruce beetle attack.

4. *Sanitation/Salvage Logging.* This alternative combines removal of dead and infested trees, and the susceptible uninfested trees in a stand. Schmid and Frye (1977) maintain that for infested stands, if the allowable cut in a given stand is more than the basal area represented by all infested and susceptible spruce, all those trees should be removed. If total basal area of infested and susceptible spruce is greater than the recommended cut, the manager has three options: remove all susceptible trees; remove the recommended basal area in infested, susceptible trees, accepting the risk of future losses; or leave the stand uncut. If the stand is cut, windthrow could be left as trap trees and removed once infested. Also, pheromone baits can be placed on spruce marked for removal to increase and concentrate numbers of attacks. These baited trees must be removed to reduce the spruce beetle population.

CONCLUSION

A sanitation/salvage logging alternative is recommended for the Neffs Management Area. Removing the infested trees before 1994 adult beetle emergence will significantly reduce further losses in this area. Within this area, removing infested trees and using trap trees to collect emerging adult beetles will help maintain the residual green tree component. If a silvicultural treatment is selected, spruce beetle management guidelines are outlined in the Appendix.

Selecting a sanitation/salvage logging alternative will reduce insect activity within the surveyed area, but further losses can be expected if beetle populations increase in areas surrounding the area surveyed. If harvesting takes place, a monitoring procedure should be implemented to detect building populations of spruce beetle in windthrown or other down material that could cause populations to reach epidimic levels.

ACKNOWLEDGEMENTS

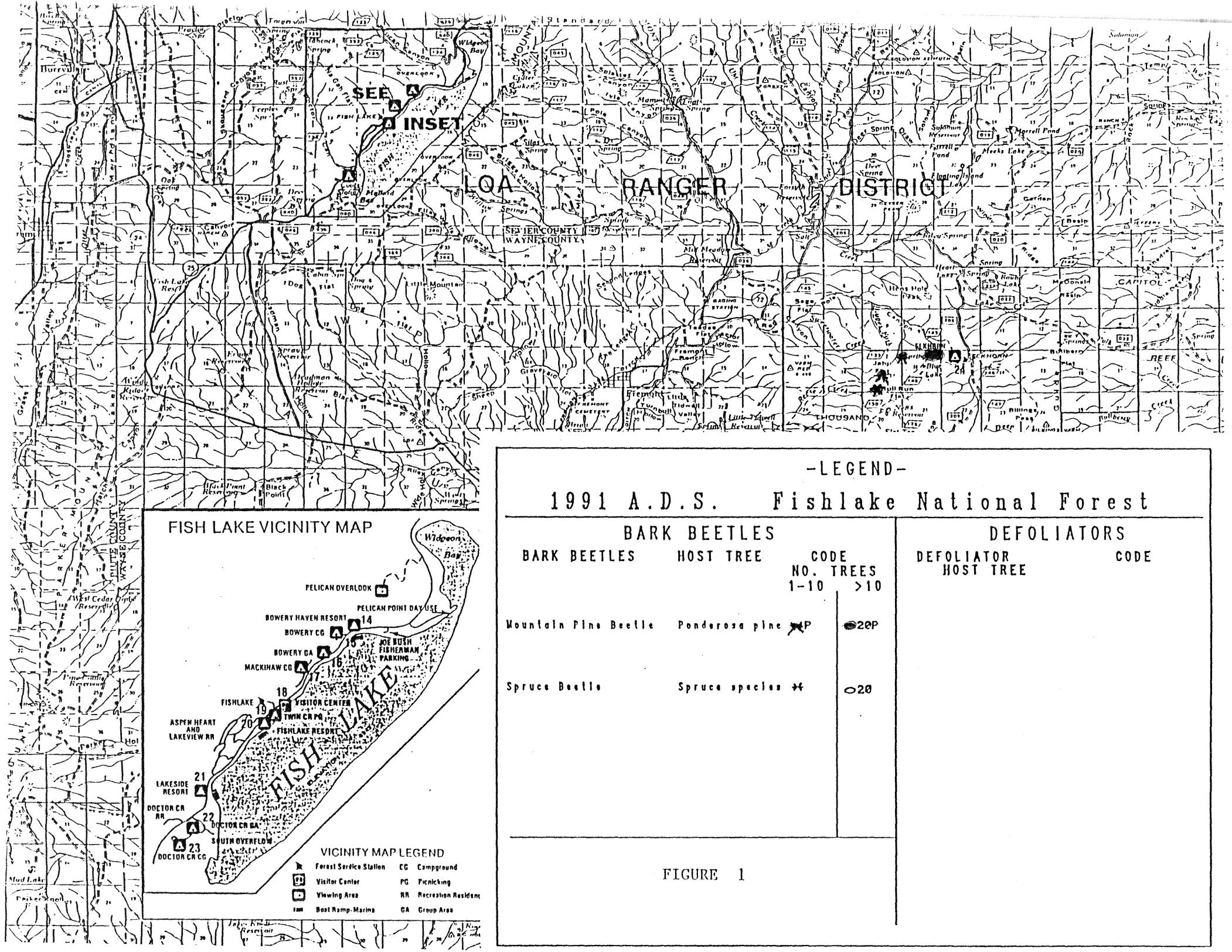
The authors appreciate the assistance of the following individuals with the data collection for this survey: Laura Todt, Mike Hoffer, Angie Gaines and Lisa Robinson.

Table 1. Species composition by basal area, trees per acre and diameter. Diameter >10 DBH was calculated as a variable for spruce beetle hazard.

	BA	%BA	TPA	>5DBH	>10DBH
Spruce	147	85	242	10.5	13.8
Subalpine fir	11	7	34	7.8	11.8
Aspen	13	8	43	7.5	12.4
TOTAL	171	100	319	9.9	13.7

Table 2. Spruce beetle activity by percent basal area & trees per acre, and avg. diameter.

Spruce Beetle	Spruce w/ DBH >5"			Spruce w/ DBH >10"		
Attack	%BA	%TPA	Avg DBH	%BA	%TPA	Avg DBH
Undamaged	83	89	10.3	80	82	13.6
Current	11	8	11.4	12	12	13.9
Last Years	4	1	15.5	5	3	17.0
Older	2	2	12.5	3	3	14.8



-LEGEND-

1991 A.D.S. Fishlake National Forest

BARK BEETLES

BARK BEETLES	HOST TREE	CODE NO. TREES 1-10	CODE >10
Mountain Pine Beetle	Ponderosa pine	P	20P
Spruce Beetle	Spruce species		20

DEFOLIATORS

DEFOLIATOR	HOST TREE	CODE

FIGURE 1

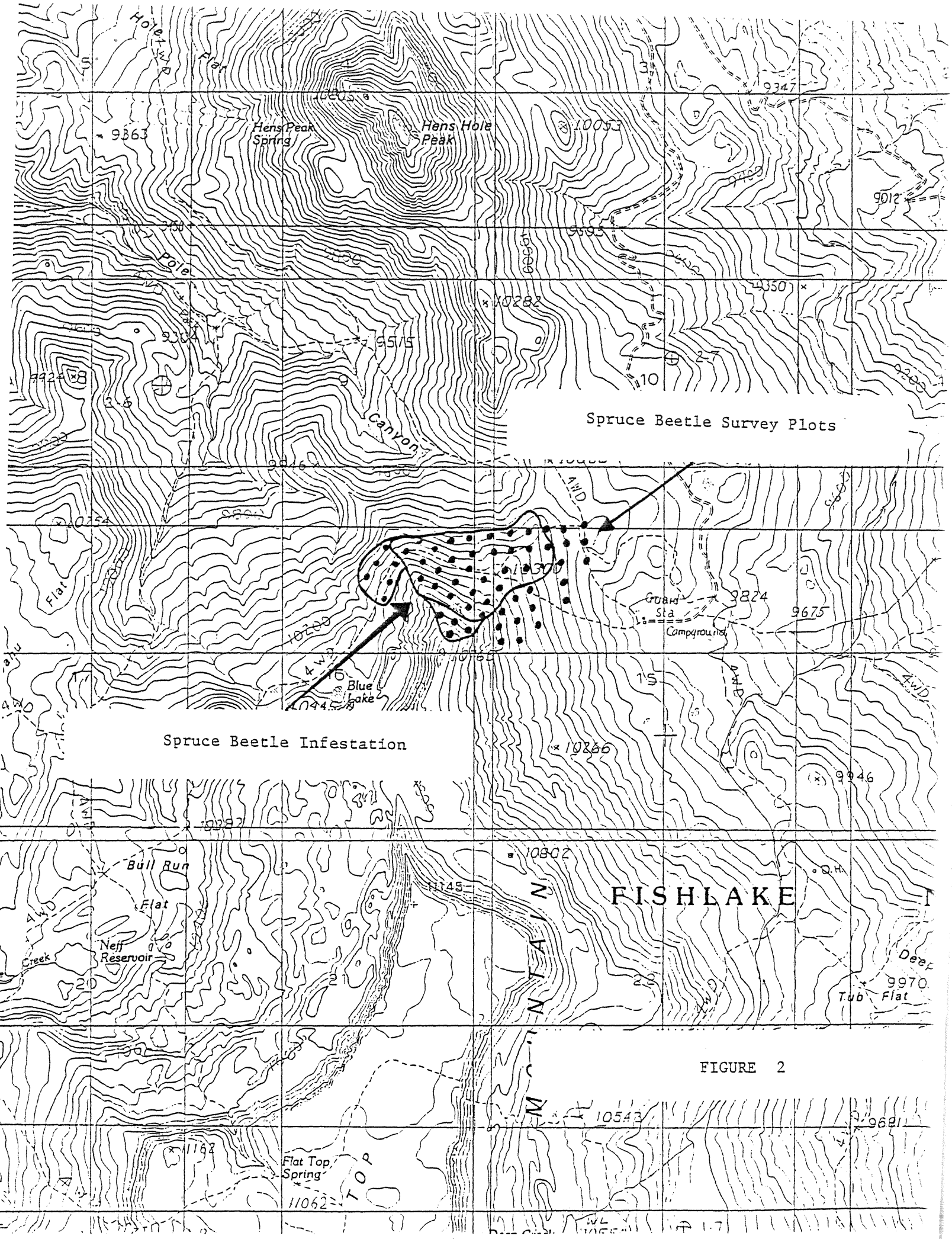

Spruce Beetle Survey Plots
Spruce Beetle Infestation
Hens Peak Spring
Hens Hole Peak
Canyon
Blue Lake
Campground
Bull Run Flat
Neff Reservoir
Creek
Flat Top Spring
FISHLAKE
Deer
Tub Flat
Hole-in-the-Wall
Pole
Flat
4WD
9863
9347
10053
9012
9515
10282
9824
9675
10766
9946
10802
11145
10543
9681
11162
11062

FIGURE 2

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APPENDIX

STAND HAZARD RATINGS FOR SPRUCE BEETLE*

1) Determine following stand conditions: Physiographic location, site index, average diameter of live spruce above 10" DBH, stand basal area, proportion of spruce in canopy.

2) Using the following table and the above stand characteristics total the corresponding rating values encloses in parentheses.

Physiographic Location	Ave. Dia. of Live Spruce Above 10" DBH	Basal Area (FT^2)	Proportion of Spruce in CANOPY (%)
Spruce on well-drained sites in creek bottoms (3)	> 16 (3)	> 150 (3)	> 65 (3)
Spruce on sites with site index of 80-120 (2)	12 - 16 (2)	100 - 150 (2)	50 - 65 (2)
Spruce on sites with site index of 40-80 (1)	< 12 (1)	< 100 (1)	< 50 (1)

3) Using the totalled rating values determine potential outbreak rating:

Total Rating Value	Potential Outbreak Rating	Preventive Action Needed
11 - 12	High	Immediately
10	Moderate - High^	Within 10 - 20 years
7 - 9	Moderate	Within 20 - 30 years
6	Low - Moderate^	Within 30 - 40 years
4 - 5	Low	40 or more years

* From:

Schmid, J. M. and R. H. Frye. Stand Rating for Spruce Beetles. Research Note RM-309. Denver, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experment Station; 1976. 4 p.

^ Intermountain Region (R-4) modification.

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Rate the stand hazard using the Region 4 modification of the rating system developed by J. M. Schmid and R. H. Frye (Stand Ratings for Spruce Beetles. 1976, USDA Forest Service Research Note RM-309). This rating system incorporates the physiographic location, site index, average diameter of live spruce above 10" DBH, stand basal area, and proportion of spruce in the canopy to predict the potential for an outbreak.

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SPRUCE BEETLE MANAGEMENT

The potential for spruce beetle infestations will be reduced by converting the stand to a less susceptible condition by removing large diameter (>16" DBH), overmature trees, and reducing the basal area of the stand to under 150 square feet. A mixture of host and non-host tree species reduces the risk of a catastrophic loss.

To prevent population buildups and subsequent outbreaks in all harvesting and cutting operations (including normal timber harvest, sanitation/salvage cutting, cutting for road right-of-ways and construction), all slash, cull and butt logs should be treated in a proper manner. Spruce should be cut as low to the ground as possible to reduce stump height, preferably less than 1.5 feet. Complete removal or destruction of larger-diameter (>14") logs, tops, and branches will prevent buildup of bark beetles (see Contract Provision C6.429#). If removal of large-diameter slash including infested, snow broken or wind thrown trees is not possible within 12 to 18 months of when the infestation or damage first occurs, the slash should be cut into small pieces (<18") and scattered into areas receiving maximum sunlight, treated with chemicals, or burned.

If a substantial spruce beetle population exists in adjacent stands, it may be wise to leave the logging residuals rather than remove or destroy them immediately after cutting. Since the beetles will seek host material as they emerge, suitable residuals will attract beetles and reduce mortality of standing trees. After infestation, the residuals must be removed or treated.

To further reduce a spruce beetle population a trap-tree method may be employed. This involves felling uninfested green trees around the infestation. The beetles will attack this down material which can then be removed with the harvest. A variation of the trap-tree is the use of attractive pheromones to lure beetles to green trees that can be removed. Pheromones are placed on the north face of large merchantable trees at a density of 2 per acre if there are spruce beetle attacks throughout the stand. If attacks are in 20-30 tree clumps, place 3 baits at each clump. Baits should be placed 7-8 feet off the ground.